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REPORT ON THE INJURIOUS INSECTS

AND OTHER

ANIMALS

OBSERVED IN THE MIDLAND COUNTIES
DURING 1906.

BY

WALTER E. COLLINGE, M.Sc., F.E.S.,

*Foreign Member of the Association of Economic Entomologists, Washington, U.S.A.;
Honorary Secretary of the Association of Economic Biologists; Editor of the
"Journal of Economic Biology"; Honorary Consulting Zoologist to the
Land Agents' Society, and the Midland Reafforesting Association;
Honorary Consulting Biologist to the Warwickshire Agricultural
Society; and Special Lecturer in Economic Zoology
in the University of Birmingham.*

FOURTH REPORT.

ILLUSTRATED.

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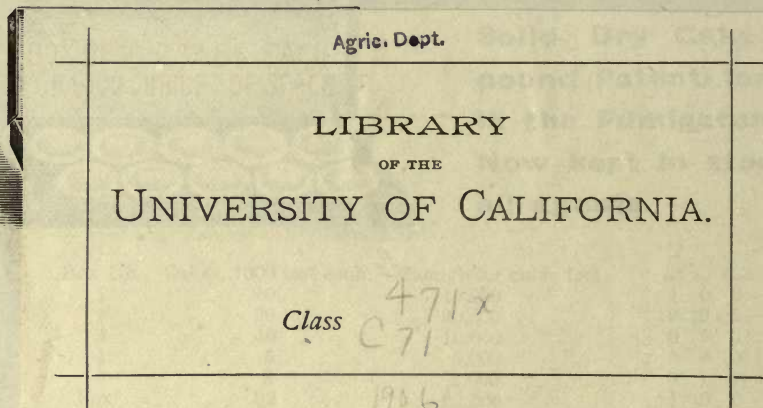
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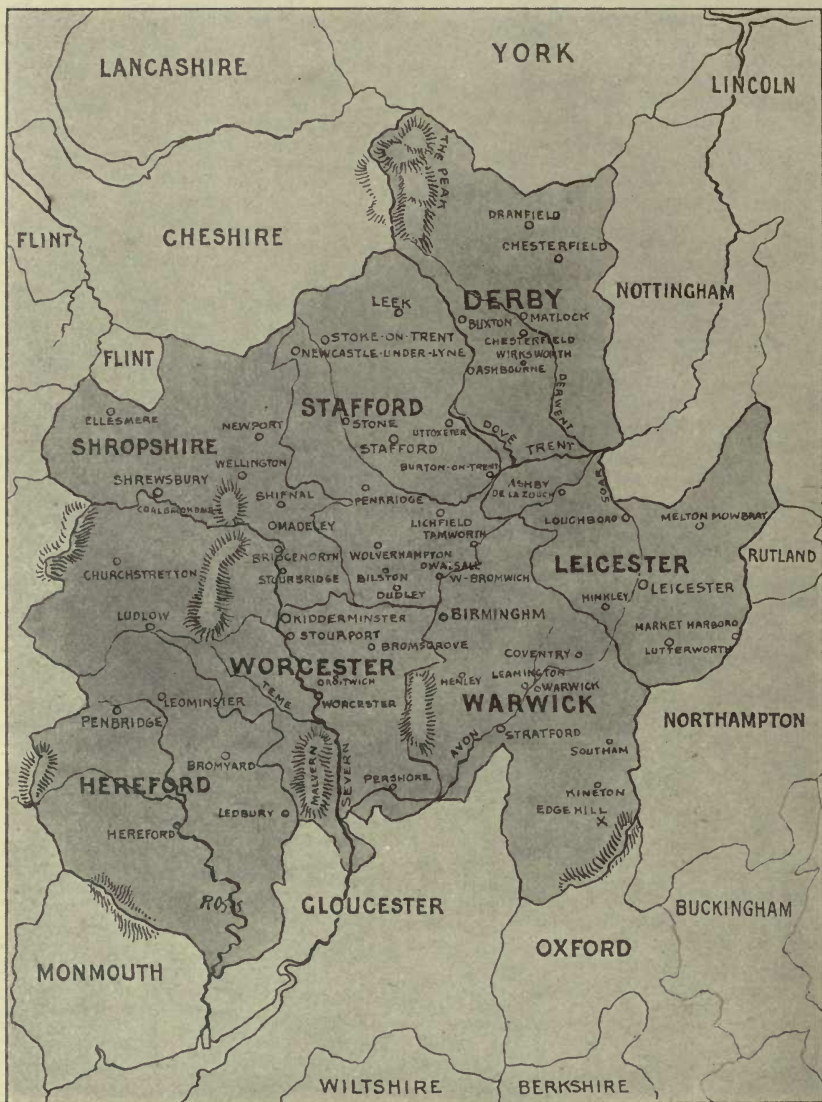
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MAP SHOWING MIDLAND COUNTIES.

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Preface.

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IN issuing a Fourth Report on the Injurious Insects and other Animals of the Midland Counties of England, received from various correspondents during the year 1906, it is again my pleasant duty to acknowledge a Grant of £10 from the County Council of Warwick aiding the publication of this Report, my thanks are also tendered to the Council of the Birmingham Natural History and Philosophical Society, for their continued assistance with my experimental work in Economic Zoology.

I have pleasure in acknowledging the kind and valuable assistance given me as regards the figures illustrating this work. To Prof. W. R. Fisher I am indebted for the loan of the Figures II—VI and 3, to Mr. G. F. Strawson for Figure I and 2, and the Controller of His Majesty's Stationery Office and the Secretary of the Board of Agriculture for Figures 1, 4, 6, 8 and 9, taken from the Board's Leaflets.

The question of the continuation of the publication of an Annual Report, of which this is the fourth, is one that will require very carefully considering. The cost of printing, illustrating, and distributing two thousand copies entails an expenditure of close upon £100, and unless further financial assistance is forthcoming the Report will, I fear, have to cease.

Each year a wider circle of agricultural and horticultural friends has been ever ready to afford me all the assistance in their power, and I value the opportunity of once again being able to thank them for their kind and valuable assistance.

WALTER E. COLLINGE.

THE UNIVERSITY DEPARTMENT OF ECONOMIC ZOOLOGY,
55, NEWHALL STREET, BIRMINGHAM,
May, 1907.

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REPORT
ON THE
INJURIOUS INSECTS AND OTHER ANIMALS
OBSERVED IN THE MIDLAND COUNTIES
DURING 1906.

"Knowledge alone is not the destiny of man upon the earth, knowledge must play its part in life."—HELMHOLTZ.

"Economic Entomology, or a knowledge of those insects which injure cultivated crops, is so vast a field of discovery, that every season brings forth fresh subjects for investigation; and although this arises in a great measure from the neglect which has attended this important department . . . it seems as if a cycle were revolving, which exhibits species previously unobserved, at intervals of greater or less extent, . . . so that enemies to the cultivator may suddenly become great annoyances in latitudes where they had been previously unknown."

JOHN CURTIS.

INTRODUCTION.

DURING the year January 31st, 1906, to January 31st, 1907, eleven hundred and seventy-one inquiries have been dealt with. Of these, eight hundred and forty were connected with agricultural and garden pests, nineteen referred to household or commercial pests, and three hundred and twelve specimens were sent in for identification.

Applications for information were dealt with from the Imperial Department of Agriculture for the Fiji Islands; the Liverpool School of Tropical Medicine; the Land Agents' Society; the Midland Reafforesting Association; and the Agricultural Committees of various County Councils.

In all, one thousand and twenty-three written replies have been sent out,

My hearty thanks are here tendered to A. H. Martineau, F.E.S., H. Willoughby Ellis, F.E.S., Robert Newstead, A.L.S., and Dr. D. Sharp, F.R.S., for assistance in various ways.

The year 1906 will long be remembered in the Midland Counties, if not generally, as one in which insects of all kinds were exceedingly abundant, some to such an extent as to form a plague; conspicuous amongst these must be mentioned the Hop Aphis, which, in spite of the most persistent efforts on the part of growers, has caused serious losses. The Apple Ermine Moth, the Lackey Moth, and the Plum Sawfly have been unusually plentiful in Worcester, Warwick, Stafford and Leicester. The Felted Beech Coccus has been reported from three Worcestershire localities, but I fear no attempt has been made to deal with a pest which is slowly but surely threatening the Beech trees of this country. A new pest to Black Currants has been met with somewhat plentifully in Worcester, viz., *Spilonota roborana*, Tr. The Vapourer, Lackey, Turnip Dart, Codling and Winter Moths have all been abundant.

The Wheat Midge and Cabbage Root Fly have occasioned much damage. There has been a marked increase of the Pear Midge in Worcester and Hereford, also the Apple Sucker and Mussle Scale.

Wasps were never more abundant, and large quantities of fruit have suffered. Concerted action on the part of fruit-growers would well repay any time and expense. Those who have watched the gradual but rapid increase of these insects during the last three years, regard the situation as one calling for immediate and drastic action.

Of injurious birds, the tits, bullfinches, chaffinches, sparrows, rooks, wood pigeons and starlings have further increased, and fruit-growers have been, and are again, urged to take some united action to check what threatens to be a serious matter in the near future if no action is taken.

A serious epidemic of Eelworms has been prevalent throughout the Midland Counties; indeed, the presence in Warwickshire and Worcestershire of the root-knot eelworm (*Heterodera radicola*) is becoming a matter for serious consideration. A thousand circulars were issued in October drawing attention to the matter, and advocating action on the part of all who had land infected.

During the past year the Council of the University of Birmingham have founded a Department of Economic Zoology, and the whole of the writer's time and services are now therein devoted.

The area which this Department will endeavour to work comprises the counties of Shropshire, Stafford, Derby, Leicester, Warwick, Worcester and Hereford.

A Register of the names and addresses of the farmers and fruit-

growers of these counties is being compiled, and already most of the Worcester, Warwick and Hereford agriculturists are entered, and a large proportion from the remaining counties.

Application should be made by letter in the first instance, stating the particular crops or branch of agriculture the applicant is interested in. Such names will be placed upon the Department's Register to receive, free of charge, copies of all future Reports, Circulars, etc.

Investigations.

During the past session the experiments upon the Black Currant Gall-Mite have been continued, particulars of which will be found on p. 9.

For some years past material has been collected with the idea of a more careful and systematic study being made of the Gall-Midges (*Cecidomyiidae*), a family of minute flies of great economic importance. It is only necessary to instance the Hessian Fly, Pear Midge, Pea Midge, and Wheat Midge in confirmation of this statement. Already the life-histories of two or three species have been carefully worked through, and much valuable information obtained.

Much attention has been given to the subject of Insect Parasites of Insects, some of the species obtained are probably new, but time has not permitted of their yet being investigated.

The experiments mentioned in my last Report upon Insecticides have been continued, and very valuable results have been obtained.

The question of some better winter sprayfluid for fruit trees has occupied much attention. It was too early to state the results in my last Annual Report, but during the year 1,000 circulars have been issued to fruit-growers detailing these, and the matter has now been actively taken up by fruit-growers, particularly those in Warwickshire, Worcestershire, and Herefordshire.

EXPERIMENTS WITH INSECTICIDES.

As stated in my last Report, p. 14, a number of experiments had been made upon the eggs of the Apple Sucker, and in November, 1905, further experiments were commenced with a mixture of

Caustic Soda (80 per cent.)	...	...	2 lbs.
Soft Soap	...	...	1 lb.
Water	...	...	10 gallons.

Later, experiments were made with a similar fluid, but double the quantity of soft soap was added.

Apple twigs, with the eggs of the Apple Sucker and Mussel Scale on, were taken and dipped into these fluids and then allowed to dry. The cut ends were first sealed, and after dipping they were placed under glass, into pots of soil, where they remained until June, 1906.

Few of the eggs were damaged, and on one twig on which there were sixteen eggs of the Apple Sucker, which was dipped into water twelve hours after being in the caustic soda solution, all the eggs hatched out.

Caustic Soda (98 per cent.)	...	...	2 lbs.
Paraffin	...	...	1 pint.
Soft Soap	...	...	$\frac{1}{2}$ lb.
Water	...	...	10 gallons.

Twigs with the eggs of the Plum Aphis were dipped once into the above fluid. There were sixty-one eggs on the two twigs, and forty-two hatched out. The same fluid was tried warm on other twigs, but the result was the same.

In a similar fluid, only containing two pints of paraffin, three twigs with eggs of the Plum Aphis on were experimented with, with the following results:—

Out of 16 eggs	only 7 hatched out.
52	30
103	57

With three pints of paraffin and the same quantities of soda, soft soap and water as mentioned above, a fluid was made and applied to a large number of twigs. The percentage of eggs killed was 55 per cent.

When the paraffin was increased to four pints the percentage rose to 70 per cent., and with five pints to 85 per cent., but fell to 66 per cent, when six pints were used,

In one case a twig having 42 eggs of the Apple Sucker, and about 60 scales on, gave a percentage of 92 per cent., and a similar result was obtained with twigs with the eggs of the Plum Aphis on.

Whilst the above laboratory experiments were being carried out, out-of-door experiments were commenced with the following spray-fluid :—

Caustic Soda (98 per cent.)	...	...	2 lbs.
Soft Soap	...	...	$\frac{1}{2}$ lb.
Paraffin	...	...	5 pints.
Soft Water	...	...	10 gallons.

The soft soap was dissolved in a gallon of boiling water, and whilst still hot the paraffin was added and beaten up into a creamy liquid. The whole of the liquid was then pumped with force through a fine spray nozzle, in the usual manner, into another vessel.

The caustic soda was dissolved in 9 gallons of rain water, and into this solution the paraffin emulsion was then poured, and the two *well mixed* together.

All the applications were made in the first week in March, and the results in the open fully bear out the excellent results obtained in the laboratory.¹

Further experiments, of which it is too early yet to give the results, have been made with the Felted Beech Coccus, the eggs of the Red "Spider," and other Aphids.

It is proposed to substitute this soda-emulsion sprayfluid in the future for the caustic soda and carbonate of potash sprayfluids given in previous Reports.

Experiments, with a view to providing a complete winter insecticide and fungicide are being carried out, also with various carbolic, lime and sulphur, and lime, sulphur and salt sprayfluids, and will be reported upon at a later date.

It may be pointed out that the results so far obtained by the different lime and sulphur, and lime, sulphur and salt sprayfluids have proved most disappointing, and other experiments, not made by the writer, with similar fluids have given very poor results. In this connection I may draw attention to a recent work by Mr. J. K. Haywood, of the United States Department of Agriculture, in which he states: "In the lime-sulphur-salt-soda wash the author is unable to see that anything is gained by the addition of salt, although it is recognized that

¹ Unknown to me at the time, a series of experiments were being carried out at the Woburn Experimental Fruit Farm, and the results obtained by an almost precisely similar sprayfluid, confirm the value of this mixture. The results are set forth in great detail in the Sixth Annual Report, and should be carefully studied by all interested. A brief summary of the conclusions arrived at in this Report has since been published.

some hold strenuously to the belief that the wash without it is a failure. Besides this it would appear that the caustic soda entirely takes the place of the lime, in so far as the caustic action of the wash on the scale is concerned. . . . Therefore a wash composed only of sulphur, caustic soda and water seems worthy of a trial." The author then goes on to recommend the following as a proposed formula :—

Water	...	...	...	50 gallons.
Powdered Sulphur	...	...	...	19 pounds.
Caustic Soda	...	...	...	10 pounds.

The sprayfluid is made as follows :—Make a paste of the sulphur with not more than $5\frac{1}{2}$ gallons of boiling water ; at once add all the caustic soda, which has previously been broken up into small pieces, and stir occasionally for half an hour. Then add $44\frac{1}{2}$ gallons of water, stir, and the sprayfluid is ready for use.

Most important results have been obtained from two sprayfluids, which for the present I shall term V 1 and V 2.

V 1 is a winter sprayfluid of great penetrative power. In one orchard, where it was tried on about 100 acres of Apple, Pear, and Plum trees, and 34 acres of various fruit trees, Apple Sucker, Apple Aphis, Plum Aphis and Mussel Scale were exceedingly bad last year. A careful inspection was made in March of some 30 to 40 of the worst attacked trees, and not a single egg of any of these pests could be found alive.

In another orchard equally good results were obtained. The trees were mostly Apple, and thick with Mussel Scale, but in spite of the most careful searching and examination no live eggs could be found. Indeed, I can confidently state that, in my opinion, on April 24th in these orchards there were fewer living insect pests in any stage to be found than I have ever previously seen.

The grower writes :—

"It gives me pleasure to inform you that since I have used your winter wash for spraying my fruit trees I find a wonderful difference. It has practically cleared out American Blight, and all other insects and fungi in my Apple trees, and I am more free from these pests and aphids generally than I have ever previously been. I consider the winter washing very effectual, and I think you have made a most wonderful stride in the art of spraying fruit trees."

One spraying was sufficient to kill the eggs of *Chermes abietis*, on branches of Larch, also *Chionaspis salicis* covering branches of Ash.

V 2 is intended to replace sprayfluids used in the spring and summer. The following are some of the reports received from fruit-growers who have tried it :—

1.—I tried the fluid on Gooseberry-bushes for red spider. It is six days since I used it, and I can see absolutely no trace of any damage done to leaf or blossom. I gave a Plum tree in full bloom a thorough drenching, with apparently no ill effect, also a Gooseberry-bush in the same stage.

“The Apple tree I used it on was only partly out in leaf.”

“I feel sure it has done good, as the leaf looks brighter and healthier all round.”

2.—“Our trees never looked cleaner, you have discovered a valuable wash.”

3.—“On Gooseberry sprayed yesterday evening with V 2 diluted 1-150, every Red ‘Spider’ I found is dead, as many as eight on one leaf.”

4.—“I don’t think there are a dozen Suckers in the whole place, the only one I found was on the branch I purposely did not spray, and this on a tree known to be badly infested.”

5.—“I have now given a good trial to the tin of sprayfluid for greenfly, etc., which you so kindly sent me a short time back. I found it a very nice wash, and I think the best I have yet tried, as when diluted with 150 parts of water, with the chill off, it killed most of the fly on my Peach trees, without damaging the young leaves. What flies were not killed were those the spray failed to get at.”

6.—“I duly well sprayed Plum, Apple, and Gooseberry trees. . . . I am free from insect pests. . . . I do not perceive any damage to foliage except a slight discolouration of the Victoria Plum trees, whereas the Greengages do not show it at all. I shall do all fruit trees again on Saturday.”

In both cases the material readily mixes with cold water, and with the minimum amount of trouble.

I may here state that it is absolutely necessary that the fluids go through a somewhat complicated mechanical process, which it is not possible for a private individual to carry out, except under great expense, which would at once place the fluids beyond the cost that a practical fruit-grower could afford to pay for a large area of trees.

Early in the present year I found that the Cooper Research Laboratory were working at the subject of Insecticides, and were experimenting with a fluid of a somewhat similar character.

I also found that they had overcome the difficulties of combining the various chemicals which it was necessary to employ in the manufacture of this fluid, so as to bring out its maximum insecticidal power without injury to the trees.

The mechanical and chemical processes which it is necessary for the chemicals to undergo are somewhat complex, and demand the pos-

session of considerable chemical knowledge. They would also involve the erection of a plant of prohibitive cost to the fruit-grower.

The Staff of the Cooper Research Laboratory have very kindly given me every assistance in their power, and have defrayed the cost of spraying several large orchards during the experimental stages. I have now made certain recommendations to them, and as the result of our joint experiments I think the fruit-grower will have in V 1 and V 2 a winter and summer sprayfluid very difficult to improve upon. In carrying out this work my thanks are due to the Laboratory Staff for the ready and able manner in which they have at all times assisted me.

REPORT AND SUMMARY OF THE 1906 INVESTIGATIONS ON THE BLACK-CURRANT GALL-MITE.

I have little to add to my previous Report, a more lengthened experience has shown that one part of finely-ground unslaked lime and two parts of sulphur acts rather better than equal parts of these.

Numerous growers in all parts of the United Kingdom have written reporting the beneficial nature of the application of lime and sulphur. I am now more sanguine than ever of arresting the further spread of this insidious pest, if growers will only continue the treatment, and carry out the instructions. Numerous statements have occurred in the Press recommending slaked lime, others state the proportions of lime and sulphur wrongly, whilst one states that the mixture may be dusted on by means of a muslin bag tied on the end of a stick!

Such statements are most misleading, and have no doubt led many to apply the wrong materials and in different quantities than I have recommended. In some of the horticultural papers these errors have been corrected, but it has been impossible to do that generally.

Experiments with sulphur in the form of a sprayfluid have been continued, but the results are not anything like so satisfactory as with the dusting.

EELWORMS.

As pointed out on p. 2, Eelworms constitute one of the worst pests with which the farmer and horticulturist of the Midland Counties has to contend.

Experiments are at present being made on a large scale with the treatment of the soil with solutions of carbolic acid. These have been undertaken with a dual object: firstly, to test the efficacy of the different solutions, and to see if one can be obtained that can be profitably employed on large areas; and, secondly, to study the after effects, if any, upon the subsequent crop.

I hope to be able to publish a short report upon the subject during the present year, in order that farmers and others may be able to treat their land during the winter of 1907-8, if it should seem desirable.

WOODLICE.

Only one case has been reported during the year where these pests have been really serious. My correspondent wrote that he had tried almost every remedy, and that all his greenhouses were overrun with the pests. During the summer they were present to such an extent that in one house it was almost impossible to grow anything.

On inspecting the different houses I decided to treat all of them with Vaporite, and to lay traps, consisting of wet wooden boards, 12 by 6 inches, which were left lying on the ground over-night and examined next morning. By this simple and uncostly method of treatment all the houses were cleared, and none have been seen for some time past.

THE MUSSEL SCALE.

Mytilaspis pomorum, Bouché.

There has been a considerable increase of this insect, and it has been reported from many orchards which have previously been known to be free from it.

It is hoped that the good results obtained with the caustic soda-emulsion sprayfluid will induce many growers to apply the same, and clear their trees of this pest. In numerous cases, where I have been able to examine the trees since being sprayed, the efficacy of this sprayfluid is confirmed.

The following letter, received from a large grower, is only one of many written in similar terms.

"It may be some pleasure to you to hear of the great benefit your prescription of caustic soda, etc., for killing Mussel Scale has been to me.

"I started spraying on March 11th, and continued to do so as the wind allowed me until all the Apple trees were finished. Some of the trees had a very bad attack indeed, so bad that on many branches not a single piece of bark could be seen, the whole surface being covered. Immediately on being treated with the soda wash the Scale turned white, and it has since shrivelled up, and the trees are left in a better condition than they have been for many years. The bark is clean and bright, and the general appearance immensely improved.

"No doubt a good many Scale escaped, as I started late in the year, and could only go over the trees once, and of course only one side of the tree can be sprayed according to the direction of the wind, but next winter I shall start in good time, and go over every tree twice, or even more, and I have no doubt that I can so reduce this pest as to be of practically no harm to me.

"I also dressed my Plum trees with the same wash with very good results. The green and moss have quite disappeared, leaving the bark in fine, clean condition. My neighbour, who made great fun of me over spraying, and absolutely refused to have his trees sprayed, has been so struck by the change in my trees that he has asked me to let my men spray his trees next winter."

THE WHITE WOOLY CURRANT SCALE.*Pulvinaria ribesii*, Sign.

I recorded this scale in my last Report from Walsall, Wednesbury, and the neighbouring district. This year I have met with it in quite a number of orchards in Worcester, though never in any great quantity.

It is a troublesome pest, and is best attacked, I think, by the use of the caustic soda-emulsion.

LIFE-HISTORY.

The larvae hatch out in June-July. At first they are extremely active, running all over the plant, but after a time they fix themselves to the wood of the previous year's growth. Towards the end of July they undergo their first moult, a second one taking place about the middle of August. After this the sexual distinction commences to appear. The following account is given by Newstead¹:—

“Both males and females are at first identical, but the former eventually assume a more elongate form, and the reticulations become more confluent. These changes give the insect a darker appearance. So soon as the elongate form is attained in the male insect, the puparium is commenced; at first there is only a faint trace of the carinae, but in a few days it is completed. Under this covering the insect changes to the first pupal stage, finally losing the mouth-organs characteristic of all the previous stages. Presumably, therefore, it takes no further nourishment from the food-plant. Towards the end of August the first pupal skin is moulted and pushed out at the anal extremity of the puparium; the true pupal form is then attained. About seven days later the white caudal filaments of the male are seen to project beyond the puparium; at first they are short, but in the course of a few days they assume their full length, when the tips of the wings may also be seen projecting beyond the puparium. The first males appear during the second week in September; they continue to emerge over a period of twenty-one days, the last hatching as late as the second week in October. In confinement the males become very restless, frequently taking a short, rapid flight, which reminds one more of a gigantic leap. When the insect is about to take flight, the long caudal filaments are carried semi-erect, and the wings are spread out and slightly elevated. I did not observe any of the males take flight out of doors, except when made to do so by disturbing them with a fine-pointed instrument. After fecundation the males die. About the end of Sep-

¹ Monog. British Coccidae.

tember the females effect their third moult, but on this occasion only the ventral skin is cast off at the anal extremity, remaining as a minute, white, shrivelled object on the bark until the wind carries it away. After this moult many of the females change their quarters, but the majority remain where they first fixed themselves as young larvae. Growth takes place immediately after the moult, and by the third week in October the insects attain a length of 3-4 mm. Their colour then closely resembles that of the bark of the food-plant, and is thus highly protective, so much so that even when the branches are almost covered with coccids, the latter are by no means conspicuous. The insects pass the winter in the stage last described, and early in March, if the weather is warm and sunny, the females begin to show signs of growth, and to secrete honey-dew; should the weather change to cold and frost, they again become dormant, as in winter; but they begin to re-eject the secretion when warmer weather again sets in. It is, however, during the last fortnight in April and the first week in May that the greater amount of honey-dew is expelled. Towards the end of April the females thicken, and the margin of the body formerly fixed to the branch becomes raised from the middle to the posterior extremity, thereby slightly exposing the underside, which presents a dull orange colour. At this stage the formation of the ovisac is commenced, but the eggs are not laid in it until the pad-like sac has attained some thickness. . . . The completion of the sac represents the period of egg-laying; individually this occupies altogether about twenty-one days, but collectively it is continued over a much longer period. The females, during the process of the formation of the ovisac, become gradually tilted up from behind, until, eventually, they are only attached to the branch by the anterior or cephalic margin, which position is maintained for an indefinite period—sometimes for two or three years. Death takes place shortly after the egg-laying period; the body then changes to a chocolate-brown, and eventually almost black, and is much wrinkled transversely.

“Summarising these observations, we find that there is but one brood in a year. The larvae hatch in June and the early part of July, the first moult taking place from the middle of July onwards; the second moult is in August, when a sexual difference is first observed. Pupation takes place towards the end of August, the males appearing in September. They then fertilise the females, when the latter moult again for the third time. Hibernation commences shortly afterwards, and the insects remain dormant until the spring. Egg-laying takes place at the end of April and throughout the early part of May. In all probability the period here set forth may vary slightly according to the season. My observations were made during the years 1899-1902,

on a colony established on a large plant of *Ribes sanguineum*, trained on a south wall, and in other ways well-sheltered from cold winds. The colony was established by attaching to the plant in question a small branch of Black Currant, tenanted by about twenty females, with their ovisacs full of eggs. In due course the larvae hatched and produced several thousand fertile females, but only one male! Thus the majority of the females were parthenogenetic. In the following year the increase from the first lot of females was enormous, and portions of the food-plant were at times covered by millions of young larvae, thousands of which perished through want of space on the seasoned wood; here and there a few examples fixed themselves upon the young and tender shoots, or more rarely upon the leaves, but none reached the first moult on the latter, and very few completed a full life on the former. The colony which survived on the seasoned wood practically covered every available portion of it.

"The second generation under observation produced a large number of males, but there was a great preponderance of females. At that period (1900) the colony was in its most flourishing condition, and every branch of the food-plant was glistening white with their ovisacs.

"With regard to the males, I noted one remarkable fact—they were almost exclusively confined to those branches which harboured the old dead females and their ovisacs of the previous year; only a very few male puparia occurred upon branches which had not been previously tenanted by the females. The wood which was tenanted by the previous generation was older, and there was naturally less space upon it for their successors; but whether this fact, together with the greatly overcrowded condition of the individuals, had any effect on the production of males, I am unable to say; but, taking all the facts into consideration, it is not probable that it had. In the numerous colonies of this species that have come under my observation I only once previously met with the male puparia, and that was under precisely similar conditions. The plant had become overcrowded, and the male puparia were fixed chiefly on the old wood among the dead females of the preceding generation."

THE FELTED BEECH COCCUS.

Cryptococcus fagi, Barendsprung.

This most undesirable pest is undoubtedly increasing in the Midland Counties, and it is very desirable that wherever it is noticed that it should at once receive attention.

For many years past, owing to the neglect of Beech trees on different estates, this scale has been allowed to remain unmolested and spread to fresh trees.

Judging from experiments made this spring, the winter sprayfluid V 1 seems likely to prove effective here ; if that should ultimately prove to be the case, it will be much easier to attack with this than with the caustic soda-emulsion.

Experiments have also been made with the fluid V 2, when the trees are in leaf, with excellent results.

THE HOP APHIS.

Phorodon humuli, Schrank.

Not for thirty years at least has this insect been such a plague. Appearing on the byne early in June, there was an almost constant migration of the pest throughout the summer.

The climatic conditions which prevailed were all in its favour, and growers were put to great expense owing to the repeated washings.

I have pointed out to many Worcester growers the necessity for spraying Plum, Damson, and other prunes with the caustic soda-emulsion sprayfluid in the winter, and again in the spring with paraffin emulsion. If some united action were taken, I am sure it would be productive of great good.

In the vicinity of many Worcestershire hop plantations there are standing to-day Damson, Plum, and Sloe trees which should have been cut down and burnt years ago. They are old, neglected trees, bearing no fruit—indeed, the only purpose they fulfil, so far as I can see, is to form a breeding ground for the Hop Aphis.

THE PLUM APHIS.

Aphis pruni, Reaumur.

Throughout the Midland Counties this insect has been most plentiful wherever Plums were grown. Not a few of the orchards have been sprayed with the caustic soda-emulsion with excellent results, others are being treated with the liquid V 2.

THE APPLE LEAF APHIS.

Aphis fitchii, Sanderson.

Thanks to the excellent work of Professor Dwight Sanderson, we now know that there are three distinct species of Aphis attacking the Apple, viz. :

The Apple Leaf Aphis (*Aphis fitchii*, Sanderson).

The Permanent Apple Aphis (*Aphis pomi*, De Geer).

The Rosy Apple Aphis (*Aphis sorbi*, Kaltenbach).

The first-named species has been the common species in the Mid-

lands during 1906. Unlike the latter two species, the Apple Leaf Aphis does not cause the leaves to curl.

Briefly, the life-history is as follows:—

The eggs hatch out about the middle of April, and commence attacking both leaf and blossom buds, the latter becoming brown and dying. In ten to twelve days the young reach maturity, and early in June they commence to migrate to various grasses, returning to the Apple about the middle of September, on which they deposit their eggs in the axils of the buds.

Spraying in the autumn with a paraffin emulsion before the Aphides lay their eggs is undoubtedly the best remedial measure, failing that, winter spraying with the caustic soda-emulsion must be carried out.

THE WILLOW APHIS.

Melanoxanthus salicis (Linn.).

A Worcester correspondent forwarded in September last specimens of this insect from a number of Willow trees, which were literally swarming with the insects in all stages of growth. The attack was first noticed in the early part of the year, and gradually became worse. In July there was scarcely a leaf left on the trees.

This species is one of the largest of the Aphides, but apparently a local one. I have not hitherto met with it in the Midland Counties.

Buckton¹ records it as occurring on Poplar trees as well as Willows.

In the above-mentioned case the trees were well sprayed with paraffin emulsion in the autumn, and up to the time of writing I have not heard of their re-appearance.

THE APPLE SUCKER.

Psylla mali, Forster.

Wherever Apples are grown in the Midland Counties the Apple Sucker has been the most serious pest that the fruit-grower has had to contend with. In Worcestershire it has proved particularly injurious.

A full account of the life-history of this insect was given in my Report for 1904.

Reports are just coming to hand of the beneficial effects that have resulted from the use of the caustic soda-emulsion, which, I am pleased to say, has been taken up by most of the fruit-growers in this country.

The following extracts from a few of these reports may be of interest, especially in view of the fact that Mr. F. V. Theobald, so

recently as March last, stated: "So far, we know nothing that will destroy them [the eggs], and it is extremely doubtful if anything will be found which will not at the same time harm the shoots."

1.—"This orchard was in a very dirty state . . . where I used the [caustic soda-] emulsion I find hardly any insect life at all, and practically no caterpillars." (Hereford.)

2.—"The only sprayfluid that has ever touched the Apple Psylla eggs. Our orchards are wonderfully free this year." (Worcester.)

3.—"I consider your petroleum caustic soda recipe a splendid one for a winter dressing, being a great check upon destructive insects." (Gloucester.)

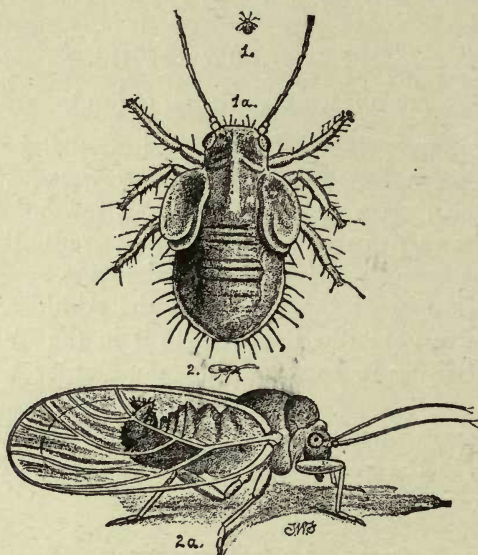


FIG. 1.—THE APPLE SUCKER (*Psylla mali*).

1.—Larva, natural size. 1a.—Larva after third moult, much magnified.

2.—Perfect insect, natural size. 2a.—The same, much magnified.

4.—"We should like to inform you that the caustic soda-emulsion recommended by you last autumn, and which we sprayed with in February, has wrought a wonderful change on our fruit trees. Last year we had Apple Sucker very badly, and Mussel Scale also, but so far this year our trees seem clear of both these pests. It has also taken off the moss, etc., and with it probably many other pests." (Worcester.)

5.—"Your wash was very effective." (Hereford.)

6.—"Last year my Apples and Currants were ruined by the Psylla and Currant Aphis. They were sprayed once with your caustic soda-emulsion, and this year they look wonderfully well and entirely free

from these pests. The fruits have not set like this for at least eight years back. I cannot speak too highly of your recommendation." (Warwick.)

7.—"I think your winter wash of caustic soda-emulsion spray is the most effective of all those I have tried, it cleared the trees of the great majority of their pests." (Hereford.)

The Evesham correspondent of the "Fruit-Grower" writes to that paper (April 4th, 1907, pp. 258, 259) as follows:—

"I have been much interested in the spraying of five acres of fruit trees here, the more so as strict account has been kept of cost, method and time. The trees are Apples and Plums, in alternate rows, 16ft. high by 12ft. through. These were sprayed for *Psylla* with winter wash (Mr. Collinge's formula). The quantity of ingredients used and cost were:—

Royal Daylight Oil, 95 gallons ...	...	£2	8	0
Caustic Soda, 98 per cent. ...	...	3	0	0
Chiswick Imperial Soft Soap, 2 firkins ...	...	1	0	0
Labour ...	...	6	0	0
Horse Hire and Incidentals ...	...	1	5	0
		£13	13	0

Or, say, 55s. per acre. The machine employed was the Canadian spray motor. Two sprays were worked at once, and the work was done very thoroughly. The nozzles were the Canadian spray nozzles (medium) one single and one with three nozzles. The latter was by far the most satisfactory and expeditious. Although it is too early yet to judge the efficacy of the work, still a great number of *Psylla* eggs show cracked under the microscope, and there is no doubt in the mind of the proprietor that incalculable good has been accomplished. But the main point of interest to growers is that this shows that spraying can be done effectively and cheaply, 55s. per acre being a moderate cost. Of course, this spraying was well planned and managed, and management in this matter is everything.

'One grower finds that his Gooseberry-bushes, grown under trees recently sprayed with the above wash, are entirely free from Red Spider, which has hitherto plagued them, while other bushes which have had no contact with the spray are badly infested. Perhaps this experience can be duplicated. Growers, please note.'

THE RHINOCEROS BEETLE.

Sinodendron cylindricum, Linn.

Two or three cases have been inquired into, where the larvae of this beetle were reported as damaging Ash trees. In all cases, however, the trees were attacked by fungi, and in a very bad condition.

So far as I am aware this beetle seldom attacks sound trees.

The only action that could be taken in the above cases was to cut the trees down, which was done, and many thousands of the larvae and beetles were found to be present.

WIREWORMS.

The experiments with Vaporite as a remedy for Wireworm have been continued with the greatest success.

In one case it was tried upon a six-acre field in which Wireworms had been present for some years. During 1905 swedes were grown, and suffered considerably. Early in 1906 the land was treated with Vaporite, an excellent crop was taken off the land, and, although I have seen and examined the land, no Wireworms could be found.

In spite of various derogatory statements, made by people who have not taken the trouble to experiment with this material, I am now fully convinced of its efficacy, and I have no reason to speak in its favour beyond the fact that I am interested in seeing these pests exterminated, and from actual experiments I am convinced of the value of Vaporite as a remedy.

EXPLANATION OF PLATE I.

Fig. 1.—Portion of field treated with Vaporite.

Fig. 2.—Portion of field not treated with Vaporite.

THE LARGE POPLAR LONGICORN.

Saperda carcharias, Linn.

In the Midland Counties this insect has been met with on several occasions. In two cases considerable damage was done to avenues of Poplars. The insect attacked the trees near the ground, rendering it peculiarly liable to be damaged later by the wind.

The eggs are deposited in crevices in the bark of Poplars and Willows (I have found the larvae in Oak also), near to the ground. These hatch out from about the middle of July to the middle of August. The larvae commence and bore their way into the wood, forming vertical galleries (Fig. 3), extending to the centre of the tree. Trees attacked can usually be identified from the fact that the wood



Fig. 1.



Fig. 2.



Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

dust is forced out by the larvae and lies around the trees. Pupation takes place in the spring of the third year, the perfect beetle emerging about June.

PREVENTIVE AND REMEDIAL MEASURES.

In nurseries where the beetles are suspected at all, the saplings should be smeared over to a height of about five feet from the ground with a mixture of clay, paraffin, and soft soap, made into a thick paint.

All saplings that are attacked should be felled and removed before the beetles emerge.

THE SMALL POPLAR LONGICORN.

Saperda populnea, Linn.

Specimens sent in of Poplars attacked by a beetle larvae were found to contain the pupae of this beetle. Unlike *S. carcharias*, the larva makes a circular gallery, which gives rise to a gall-like swelling (Fig 4). Later, the larva forms short vertical galleries.

EXPLANATION OF PLATE II.

Fig. 1.—The Large Poplar Longicorn Beetle.

Fig. 2.—Larva of the same.

Fig. 3.—Burrows made by the Larva in the stem of a young poplar.
a. Plug of boring dust.

Fig. 4.—Burrows of the Small Poplar Longicorn Beetle, in an aspen twig, showing two flight holes.

Fig. 5.—View of the interior with the larval burrows exposed.

THE PINE BEETLE.

Myelophilus piniperda, Linn.

Five cases have been reported upon during the past year where much mischief had been done by the larvae and beetles of this insect.

LIFE-HISTORY.

The female deposits her eggs, which number 100 or more, on standing timber, selecting the lower portions of the stem, also on dying or felled timber, or on tree stumps. There is no breeding chamber made as in the case of some allied genera, the eggs being laid in small tunnels in the bark. The larvae hatch out in from fourteen to twenty-one days, and at once commence to eat their way beneath the bark, forming a series of smaller tunnels at almost right angles to the main tunnel. At the end of these tunnels the small, legless

larvae pupate during June, the beetles appearing at the end of June, the commencement of July, or even later. The first developed often produce a second brood.

The beetles then fly to the surrounding trees and commence boring into the young shoots, doing great damage.

Hybernation takes place in tree stumps, the roots of standing trees, or in the rough bark at the lower part of the trunk.

PREVENTIVE AND REMEDIAL MEASURES.

All timber known to be infected should be felled, barked, and the bark burnt.

Old stumps and broken stems should be taken up or barked.

On all felled timber the bark should be removed not later than the beginning of April.

Trap-trees should be cut, and the pieces placed against the lower part of standing timber; in these pieces the beetles lay their eggs. Not later than the end of May these props should be collected and barked, and the bark burnt.

EXPLANATION OF PLATE III.

Fig. 1.—Piece of Pine bark showing the burrows of the Pine Beetle (*Myelophilus piniperda*, Linn.).

Fig. 2.—Imago.

Fig. 3.—Larva.

Fig. 4.—Pupa.

THE ASH BARK BEETLE.

Hylesinus fraxini, Pz.

Three cases of damage to Ash trees have been reported upon. In all three the trees were perfectly sound otherwise.

The female beetle lays her eggs on the stems and branches about the end of April, and the larvae hatch out in about twenty-eight days, becoming full-fed and pupating towards the end of June, and remain in the burrows in the bark until the following April.

The mother and larval galleries, and pupal chambers are well illustrated in Figure 1, Pl. IV.

PREVENTIVE AND REMEDIAL MEASURES.

On young Ash trees, spraying with a mixture of carbolic acid and 75 per cent. alcohol gave very good results.

Trees badly attacked should be barked in June, and the bark burnt.

Tarring the trees has been tried, but with only partial success.

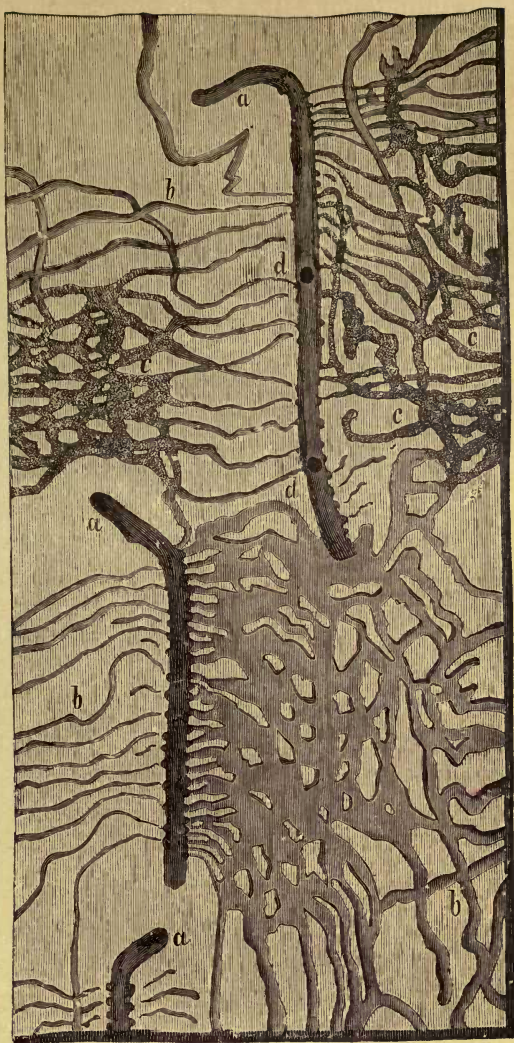


Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 1.

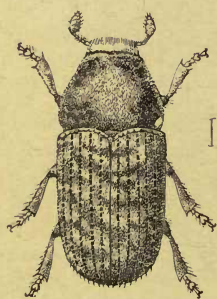


Fig. 2.

EXPLANATION OF PLATE IV.

Fig. 1.—Burrows of the Ash Bark-beetle on ash sapwood. (*Natural size.*)

a.—Mother galleries.

b.—Larval galleries.

c.—Pupal Chambers.

Fig. 2.—The Ash Bark-beetle (*Hylesinus fraxini*, Fabr.).

THE CABBAGE GALL WEEVIL.

Ceuthorrhynchus sulcicollis, Gyll.

Many correspondents in Worcester, Warwick, Shropshire and Stafford have written respecting the damage done by the larvae of this beetle.

Some experiments were made with Vaporite on infected and uninfected turnips, and although not perfectly successful, they indicate that if this material had been put down earlier much better results would have been obtained.

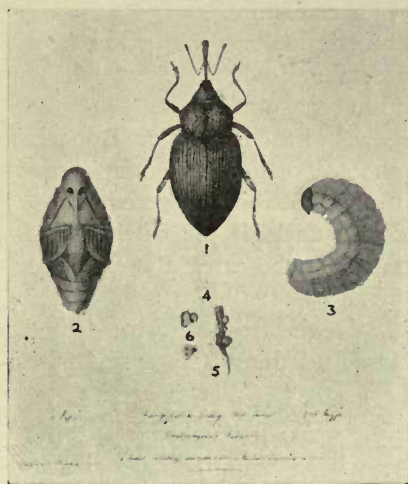


FIG. 2.—THE CABBAGE GALL WEEVIL.

1.—Weevil. 2.—Pupa. 3.—Larva. 4-6.—Galls.

LIFE-HISTORY.

The female deposits her eggs on the roots of cabbages and turnips, or with her proboscis excavates small holes, into each of which she usually places a single egg. In about ten days the larvae hatch out, as short, thick, legless, yellowish-white maggots, and around each a small swelling arises known as a gall. Within this the larva passes

the winter, and when full-fed it leaves the gall, and in the earth makes a cocoon consisting of an internal gummy-like substance, surrounded by particles of earth. It remains in the pupal stage about eight weeks.

In the early part of the year this life-cycle takes place on such cruciferous plants as Charlock, and later on the cabbage and turnip.

PREVENTIVE AND REMEDIAL MEASURES.

Charlock and all cruciferous weeds should be destroyed.

All infected cabbage stalks should be burnt, instead of being allowed to rot in heaps or buried in the ground. In both cases the propagation of this pest is favoured, for the larvae make their way from the galls into the earth, where they pupate, and later the beetles emerge ready to infect a new crop.

THE CURRANT CLEARWING MOTH.

Sesia tipuliformis, Linn.

In both Currant and Gooseberry stems, but particularly in the former, the larvae of this moth has been received from Warwickshire, Leicestershire, and Worcestershire.

An account of the life-history was given in my Report for 1904, so that it is only necessary to here repeat what was said respecting preventive and remedial measures.

Whenever the leaves of a Currant or Gooseberry tree commence to wither, and the shoots to die, for no apparent reason, the larvae of this moth are in all probability present, and, if found, the tree should be closely pruned and all the cuttings burnt.

Cuttings should always be carefully examined for any signs of the moth before planting.

I am informed that if the trees are well dusted with soot and lime in equal parts, in May and June, the moths will not lay their eggs on such.

Some trees which I have under observation, and upon which a number of experiments have been made, I hope to report upon at a later date.

THE HORNET CLEARWING MOTH.

Sesia apiformis, Fabr.

Two cases of serious injury to Alder, and one to Poplar, have been reported upon during the past season.

LIFE-HISTORY.

The female moth appears in June, and early in July she deposits her eggs in cracks in the bark of Alder and Poplar on the lower parts

of the stem. The dirty white larvae appear at the end of July or early in August, and at once commence to bore galleries in the tree. They invariably commence low down on the tree, and often form large cavities on one side of the tree only, later passing up the centre of the stem. Young trees in consequence suffer considerably from the wind, being broken off where these cavities occur.

The larvae remain active in the galleries until the May of the third year, when they pupate, forming a cocoon of the wood dust. Very occasionally the larvae pupate in the ground.

PREVENTIVE AND REMEDIAL MEASURES.

Wherever the moth is suspected, the lower portions of saplings and young trees should be smeared over with a mixture of clay, paraffin, and soft soap, made into a thick paint.

Saplings badly attacked are best cut down and burnt.

Towards the end of June the moths may be seen on the tree trunks, and should be destroyed.

THE COMMON SWIFT MOTH.

Hepialus lupulinus, Linn.

A correspondent forwarded in April the larvae of this moth feeding upon the roots of Phlox and Budbeckias, where it had done much harm. It has also been reported as damaging Daffodils and other garden plants.

Wherever suspected the soil should be turned over, and the larvae collected and destroyed. Dressing the soil with Vaporite will also prove effective.

THE COMMON VAPOURER MOTH.

Orgyia antiqua, Linn.

The larvae of this moth have been sent in by many correspondents. In most cases Apple and Plum trees were attacked, but Rose, Lime, and Poplar trees have been damaged.

LIFE-HISTORY.

The female deposits her somewhat flattened eggs in numbers varying from 250 to 300. Usually they are deposited on or close to the cocoon from which she has emerged. They hatch out in from fourteen to twenty-one days, but not unfrequently some remain unhatched until the following year, as first pointed out, I believe, by Newman.

The young caterpillars at once commence to make their way all over the tree. As soon as full-fed the larva spins a cocoon, which it attaches to the bark of the tree or to twigs, or it may be to the leaves. The moths emerge about twenty-one days later. Those eggs which remain unhatched until the following year hatch out in May, so that it is possible for a second brood to appear in the same year.

PREVENTIVE AND REMEDIAL MEASURES.

As the female moths are unable to fly, grease banding should be carried out.

All egg masses and cocoons should be destroyed in the winter.

Spraying with arsenate of lead will destroy the caterpillars, but on fruit trees this should be carried out some time before the fruit is gathered. The sprayfluid is prepared as follows:—Dissolve 1 oz. of arsenate of soda in warm water, and add 16 gallons of soft water. Dissolve also 3 ozs. of acetate of lead in soft water, and add to the above and stir well. To this sprayfluid either 2 pints of a paraffin emulsion may be added or 2 lbs. of treacle.

THE LACKEY MOTH.

Bombyx neustria, Linn.

Throughout the Midlands this moth has been unusually plentiful during the past year. In other countries the caterpillars of this moth have at times done serious damage, and it would be unwise to neglect the carrying out of proper methods until the pest becomes a plague.

LIFE-HISTORY.

The moths appear in July. About the middle of that month or early in August the female deposits 300 to 400 greyish-brown eggs. The egg masses usually take the form of a close spiral, and form cylindrical masses around the young stems and shoots. A Worcester correspondent, however, writes that the moths have been so prolific in his district that they have not only deposited the eggs in bands, but on the cocoons, and scattered them everywhere. For the first time he had noticed them on Black Currants.

Early in the following May the small, black, hairy caterpillars appear, and immediately commence to spin webs, which are enlarged from time to time. Here they live in companies varying from 30 to 100 until full-fed. During the day time they leave these webs and feed upon the leaves, returning at night or during wet weather. In fine sunny weather the somewhat handsomely-coloured caterpillars may be seen suspended from the branches by threads, or if disturbed they will let themselves down in this manner.





Fig. 1.



Fig. 2.

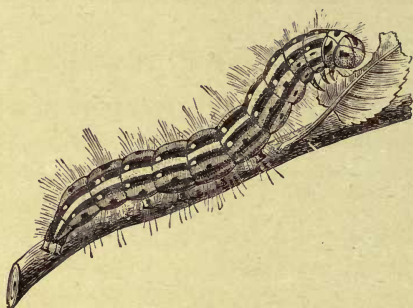


Fig. 3.



Fig. 4.

They become full-fed towards the end of June, prior to which, however, they leave the webs and no longer live in companies. In some sheltered spot, such as bark cracks, between leaves, under roofs of out-buildings, etc., they spin a golden yellowish-coloured cocoon, the moths hatching out in July.

PREVENTIVE AND REMEDIAL MEASURES.

All twigs and prunings bearing the egg masses should be burnt during the winter.

Such birds as the cuckoo, blue tit, etc., feed upon the larvae.

In orchards the webs should be collected and destroyed, and all leaves, long grass, and undergrowth should be burnt.

Much damage will be saved by spraying with arsenate of lead as soon as the larvae are noticed.

EXPLANATION OF PLATE V.

Fig. 1.—The Lackey Moth (*Bombyx neustria*, Linn.). ♀

Fig. 2.—Egg-ring on a twig.

Fig. 3.—Larva.

Fig. 4.—Pupa.

THE MARCH MOTH.

Anisopteryx aescularia, W. V.

The larvae and wingless females of this moth have been received from different correspondents, with complaints of the former damaging Apple, Pear, Elm, and Oak trees.

As in the case of the Winter Moth, grease banding should be resorted to. Trees that have been sprayed in the winter with the caustic soda-emulsion, and are, in consequence free from moss, lichens and broken bark, are much less likely to be attacked than neglected trees.

THE TURNIP DART MOTH.

Agrotis segetum, Schiff.

This is one of the most destructive pests we have in the Midland Counties at the present time; many agriculturists, horticulturists and nurserymen have complained of its depredations, which have proved of a serious nature in some cases.

LIFE-HISTORY.

The females lay their eggs on the ground or on the plant from the end of June to the end of August, and the caterpillars emerge in

about fourteen days. At first they feed above the ground, and are exceedingly destructive, as they usually bite the plant just between the stem and the root, later they destroy the tops of different plants, and as winter approaches they go below the surface, feeding upon the roots.

During the winter they may continue to feed, or they form an earthy cocoon, in the cavity of which they remain until the following spring, when they again commence to feed. Pupation takes place usually early in June, and the moths emerge about twenty-eight days later.



FIG. 3.—Male and female Turnip Dart Moths.

PREVENTIVE AND REMEDIAL MEASURES.

The preventive measures are few, such birds as the starling, rook, jackdaw, magpie, plover, and partridge undoubtedly destroy large numbers of the larvae, and should consequently be encouraged.

Handpicking the larvae is most effective. Curtis¹ mentions that Lord Suffolk "cleared a field of eight acres of swedes by handpicking: a boy followed each hoer, and collected upwards of 1,000 daily. Above 16,000 were picked at an expense of less than two shillings per acre."

Watering with various fluids, the application of lime, and soaking the seeds in various substances have been tried, but none have proved of much value.

Recently I have experimented with Vaporite with excellent results; indeed, I am of opinion that this is the best remedy we have yet for this and allied pests.

THE CODLING MOTH.

Carpocapsa pomonella, Linn.

A full account of this pest, together with preventive and remedial measures, was given in my Second Annual Report (1905), and I have nothing to add to it.

¹ Farm Insects, p. 124.





THE PINE BUD TORTRIX.*Retinia turionana*, Hubn.

Two cases of damage to Scotch Pines by the larvae of this moth have been reported on.

LIFE-HISTORY.

The female deposits her eggs towards the end of May or early in June. A single egg is laid on the middle bud of the whorls. The larva hatches out in about ten days, and at once bores its way into the centre of the bud, destroying the same. Occasionally the lateral buds also are attacked.

Pupation takes place about the middle of May in the following year, and the moth emerges at the end of May or early in June.

The same measures as recommended for the Pine Shoot Tortrix should be carried out wherever possible.

THE PINE SHOOT TORTRIX.*Retinia buoliana*, W. V.

Various correspondents in Staffordshire and Leicestershire have forwarded the larvae of this small moth, together with the injured shoots of Scotch Pine.

LIFE-HISTORY.

The moths appear towards the end of June or early in July. The female deposits her eggs among the terminal buds, and the caterpillars hatch out late in August or early in September. In the latter month they hibernate in the buds, and pupate the following May at the bases of the injured shoots. Infested trees are easily identified by the distorted shoots, the injured ones turning downwards, whilst those which have been destroyed usually die, leaving stumpy growths, due to the unnatural development of other buds. The pupal stage occupies about twenty-eight days.

PREVENTIVE AND REMEDIAL MEASURES.

The only measure of any value, and it is not always possible to carry out, is to remove all injured shoots, and burn the same.

EXPLANATION OF PLATE VI.

Pine branch, showing distortion after antecedent injury by the larva of the Pine Shoot Tortrix.

a. A larval gallery exposed. Nat. size.

THE APPLE ERMINE MOTH.

Hyponomeuta malinella, Zell.

Numerous correspondents in Leicester, Stafford, Warwick, and Worcester have forwarded the tents formed by the larvae of this moth. With one exception they were all from Apple trees, and were present in great numbers.

There seems to be some little doubt as to whether the Apple Ermine is distinct from *H. padella*, L., a species common on the Hawthorn. Having bred both these species during the past season, and given some attention to the matter, I agree with those entomologists who regard the two as distinct.

From a very general examination it will at once be seen that the species on the Hawthorn is rather larger than that occurring on the Apple, and there are also slight, but fairly constant, differences in the colour and markings of the wings.

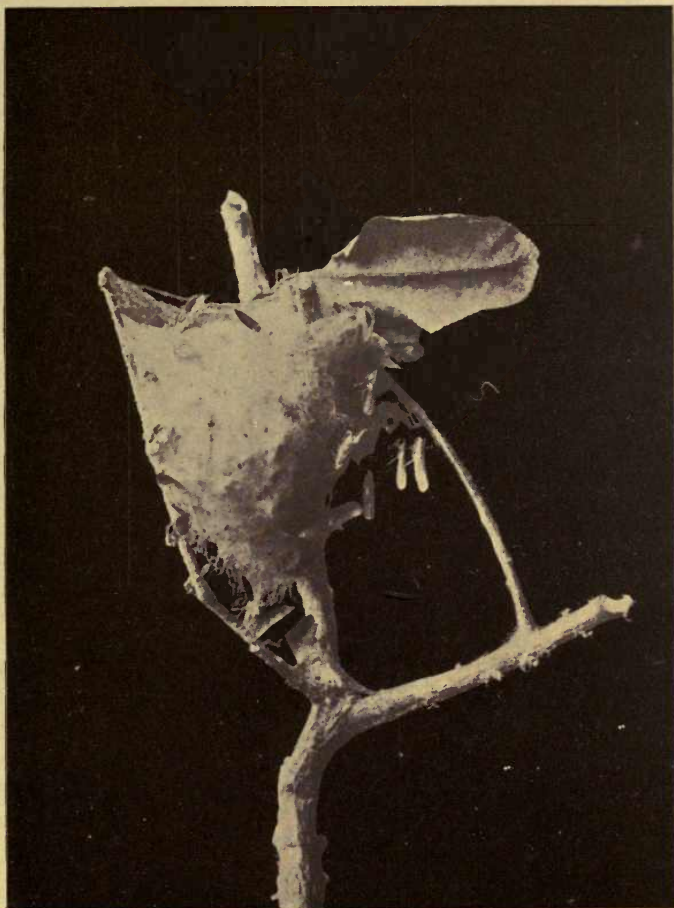
LIFE-HISTORY.

The moths were first seen on July 2nd, and the first larvae received on June 8th. Only a very few of these were reared, as quite two-thirds were parasited by a small hymenopterous insect, *Limneria tibialis*, Grav. Some authors state that the moths appear towards the end of June, and this would appear not at all unlikely.

The eggs are deposited by the female moth in small circular masses on twigs and branches of the trees, and covered over with a gummy secretion, which, at first yellow in colour, soon resembles the colour of the bark. Each mass contains an average of sixty eggs, which hatch in the autumn, the tiny pale-yellowish larvae remaining within the gummy coverlet throughout the winter. Early in the spring they escape from these nests and make their way into the buds. Here they commence to mine the leaves, tunnelling in all directions, feeding upon the soft layers of cells in the middle of the leaf. The number of larvae in the leaf varies, but ten may be taken as an average. Later they feed upon the leaves and blossoms. By this time they have increased in size, and changed from pale yellow to an ashy grey with fine black spots, which colour deepens, and the spots become more conspicuous as the larvae grow older. They now become gregarious, and spend the remaining portion of their larval stage in grey, silky tents, spun between the leaves, and later amongst the twigs (Pl. VII).

These tents are plentiful in May, and continue to increase in size. Towards the middle of June the larvae commence to form cocoons very close to one another, in which they pupate, and the moths appear in about twelve or fourteen days time.

Tent of Apple Ermine Moth, with moths just emerged.





PREVENTIVE AND REMEDIAL MEASURES.

Much good can be done by collecting the tents with the inhabiting larvae and burning them.

Spraying in the winter with the caustic soda-emulsion will, I believe, prove the best remedial measure.

Starlings will occasionally feed upon the larvae, as do also tits.

THE HAWTHORN ERMINE MOTH.

Hyponomeuta padella, Linn.

Like the preceding species, this has been unusually plentiful during the last summer.

The life-history is very similar to that of the Apple Ermine, and the same preventive and remedial measures apply.

THE MEDITERRANEAN FLOUR MOTH.

Ephestia kuehniella, Zell.

In certain flour mills in the vicinity of Birmingham this moth has been the cause of considerable trouble. The only effective remedy is fumigation with bisulphide of carbon; but there seems a reluctance on the part of millers to take such drastic steps.

The history of this insect is of more than passing interest. Until 1877, when this moth was discovered in a flour mill at Halle, Germany, it was practically unknown. It was described by Zeller as a new species in 1879. It seems, however, that it was known to practical millers in France as early as 1840. In 1884 it was observed in Belgium, in 1885 in Holland, and in 1886 in England. Till then it was thought to be an importation from America, but nothing was known of the insect on the American Continent until 1889, when it appeared in a mill in Ontario, Canada, later spreading to the United States.

There is fairly reliable evidence to show that the Mediterranean region was probably its centre of dispersal. The eggs are laid by night, either singly or in chains of 8-10, a single female producing about 200 eggs. Five or six days are occupied in egg-laying, after which the female dies in a day or two. The eggs hatch in eight to nine days. At first the larvae are very tiny, 1 millimetre in length, but in five to six weeks they become full-grown, measuring half an inch. Like many grain-feeding insects, they spin fine silken threads. The cocoons are formed of silk mixed with flour.

THE OAK LEAF ROLLER MOTH.*Tortrix viridana*, Linn.

Mr. J. G. Blakey, of Redditch, writes:—"This season the caterpillar of the above moth has been very destructive in this district; there is a good deal of Oak timber around Redditch. A wood about half a mile out, called Pitcher Oak Wood, the property of the Earl of Plymouth, was nearly denuded of foliage—some people had an idea that the Oak was late coming into leaf. A large portion of the above wood was almost destitute of foliage on the 20th of June, and looked like a winter scene. I intended taking a photograph, but my time was then taken up so much. I have felt very sorry that this was not done. I had anticipated a very bad attack from seeing so many moths last year. Such destruction must make much difference to the timber production on a large estate. I noticed particularly that the house sparrow was one of the busiest destroyers in the way of birds. Near to a window in my dwelling was a sparrow's nest, and it was most amusing to see the old birds bringing in the moths to feed their young; they would carry several moths in their beaks during each visit. I also noted that a species of Ichneumon Fly, with yellow and black markings, was very busy with the caterpillars. I noticed these Ichneumons carrying something into one of our plant houses, so I carefully followed them; when I found they put the caterpillars down for a time, then took them off again, so I came to the conclusion that they were depositing their eggs in the caterpillar. I ought to have kept some of the caterpillars, so as to have seen the result. I hope to do so another season."

A NEW BLACK CURRANT PEST.*Spilonota roborana*, Tr.

In Worcester a new Black Currant pest has made its appearance, in the form of a small Tortrix moth, the larvae of which behaves very much in the same manner as an American pest, the Currant and Gooseberry fruit worm (*Zophodia bella*, Hulst.)

The larvae, which were first seen by me on June 15th, feed upon the fruits as soon as set, eating a hole in the side large enough to enter, and after devouring the whole of the interior of one berry, it passes on to another. The leaves and empty fruits, or partly eaten ones, are loosely webbed together.

The larvae continue to feed until nearly the end of June, when they become full-fed and pupate on the bushes, the moths appearing in about three weeks time.

So far as I can learn, there is no previous record of the larvae of

this moth behaving in this manner, and one can therefore only regard it as a change in the feeding habits, which is likely to prove serious to growers of Black Currants.

It was too late when last year to try the effects of any spraying, but I hope to do so this season.

THE CHERRY FRUIT MOTH.

Argyrethesia conjugella.

Another Tineid pest was reported by a correspondent in Worcester attacking Cherries. It has not previously been met with in the Midlands, and it is to be hoped that it will not re-occur this season.

THE CABBAGE ROOT FLY.

Phorbia brassicae, Bouché.

This is a pest particularly prevalent in the Midland Counties, and, I regret to state, one that is slowly but surely extending itself over a wider area.

The fly is not unlike the common house-fly in general appearance, though smaller, and with proportionately larger wings. Many of the flies probably hybernate during the winter.

Early in May the female deposits about fifty eggs, either on the surface of the ground near the plant, or upon the plant stem, and the larvae hatch out in about seven or eight days.

Washburn¹ gives the following account of egg-laying, as observed by one of his assistants:—"When a fly lights on a plant in search of a place to deposit her eggs she runs quickly down the stalk to the ground. Here she searches alternately with her forward or rear end or ovipositor for some crevice or crack through which she can obtain access to the stalk of the plant underground. She acts rather nervously, occasionally running up on to the leaves. The ovipositor is, when extended, nearly as long as the abdomen, very flexible and pointed. With this she tries every place offering any chance of furnishing what she desires. When she has finally found a crevice, she forces the ovipositor in to the limit, and stands still for several seconds, meanwhile usually polishing her head with her fore pair of legs. Then withdraws her ovipositor, and, after climbing on to the plant again, flies with a slow flight near the ground to a point of vantage or to another plant. I watched five flies at work, and they all laid eggs while I was watching them. Only one of them laid more than one egg in a place, and

she laid two. The eggs were carefully concealed, and were not visible from outside without disturbing the soil."

Given food, the larva quickly grows, becoming full-fed in about twenty-one days.

When full-fed the larvae make their way into the soil, but they may remain in the plant. The larval skin hardens, and forms a puparium or external covering for the pupa within. The time the insect remains in this stage varies considerably; indeed, it may be anything from a fortnight to several months: those flies that emerge in a fortnight or so give rise to another brood, and this may be repeated several times, the final pupa of the year remaining in the soil until the following spring.

In addition to cabbage, swedes, turnips, and radishes, many other plants are attacked.

PREVENTIVE AND REMEDIAL MEASURES.

Farmyard and organic manures generally are said to attract the flies, and should therefore be avoided.

Where bad attacks have been experienced, cabbages and all cruciferous plants should not be grown on the same land for at least two years.

Professor Slingerland, in 1894, suggested the use of discs or cards of tarred paper, applied around the stalk. The object is to fit the cards close to the stem and the ground, so that the fly cannot get under it. She will then be forced to deposit her eggs on the card or on the soil beyond it. In either case the larva, when hatched, are unable to reach the plant. I am informed that the use of these cards by large growers in the United States has given most successful results, but I have not found any large growers in this country who will entertain such a method.

Sand saturated with paraffin and scattered around the plants has proved useful on small areas. Half a pint of paraffin to a bucket of dry sand.

Carbolic acid and lime made into a thin cream and applied in a similar manner has given good results, as also two pounds of glue dissolved in a gallon of water and mixed with one-half pound of bran (Washburn).

THE CARNATION FLY.

Hylemia nigrescens, Rnd.

The larvae of this fly have been received from many Midland horticulturists and nurserymen. It has proved a most troublesome pest, and one difficult to attack.

Some observers have stated that the larvae pupate in the soil, but in both pinks and carnations I have always found the pupae in the stem.

A weak solution of carbolic and paraffin was sprayed over some carnations growing quite close to a lot affected with this fly, but they remained perfectly free from it. I have recently examined them, and find them perfectly healthy and free from the larvae.

I am informed that mixing soot with the soil previous to layering has proved effective, but I have no personal experience of its efficacy.

THE PEAR MIDGE.

Diplosis pyrivora, Riley.

Although the Pear Midge has increased in many orchards, it has been almost entirely destroyed in others by the simple method of burying the surface soil.

A correspondent, in whose orchards it was not practicable to turn over the surface soil, owing to the large number of surface roots, carted on to the land sufficient soil to make a layer four or five inches deep, and it proved most successful.

Wherever Kainit has been used, it has proved a waste of time and money; and once again I would warn fruit-growers of going to the expense of applying this material, which is practically useless.

Having in previous years written at some length upon this pest, and devoted considerable time to the study of its life-history, it is with no little surprise that I have read the account given by Mr. Cecil Warburton, in the Journal of the Royal Agricultural Society (1906, Vol. LXVII, p. 271). It is there stated that, "It is only thirteen years ago since the Pear Midge was first recorded in England." I would point out that it was referred to by Edward Newman (Entomologist, 1875, VIII, p. 167 and 189), who states that he received affected pears from Henry Reeks, of Thruxton, in the spring of 1874 or 1875. It is also recorded by Meade (Entomologist, 1888, Vol. XXI, p. 123). Miss Ormerod makes mention of it in her Report for 1884, and I myself examined fruitlets with the larvae in taken in Worcestershire in 1894. I have been informed by certain Midland fruit-growers that it was known in the Midlands fully thirty years ago. From available evidence this would seem to be about the time that it appeared in this country.

It is further stated that in the case of infection "it will be cheaply got rid of if every pear on that particular tree is sacrificed." And again, "the practical points are these: that during the month of May the grubs are in the young pears, and are destroyed by picking off and burning the infested fruit."

I fear the amount of labour involved in picking off the pears from the trees of even a medium-sized orchard is scarcely realized. Such a method might be worth while carrying out on a few trees, but it is not practicable where large numbers are concerned.

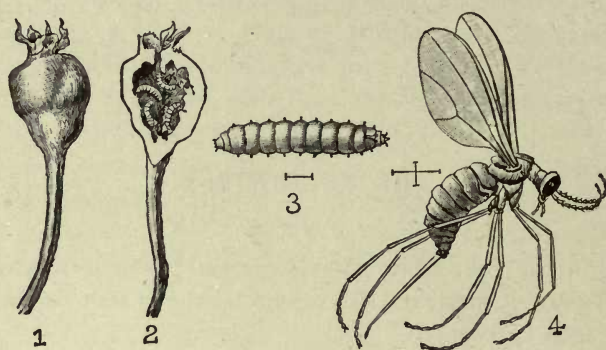


FIG. 4.—THE PEAR MIDGE (*Diplosis pyrivora*).

1.—Pear stunted and malformed by the larvae within it. 2.—Section of pear showing larvae within. 3.—Larva, much magnified. 4.—Female Midge, much magnified, lines show natural length of midge and larva.

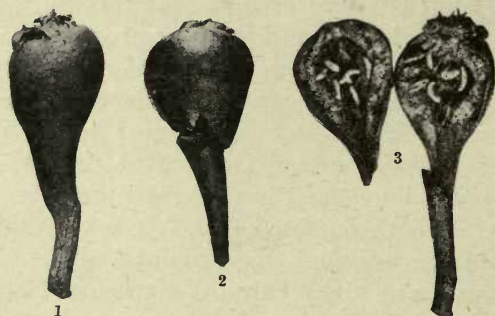


FIG. 5.—THE PEAR MIDGE (*Diplosis pyrivora*).

1 and 2.—Distorted pears containing larvae. 3.—Section showing larvae within.

THE WHEAT MIDGE.

Diplosis tritici, Kirby.

Two cases of wheat infected by "Red Maggot," from Warwickshire correspondents, have been examined and reported upon during the past year. Not having dealt with this insect in any previous Report, some account of the life-history and habits may be useful.

LIFE-HISTORY.

The female midges make their appearance at the end of May or early in June, and lay their minute, transparent eggs on the wheat

blossom. They average 15 to 30 in number. Miss Ormerod ¹ mentions that the females "may be seen laying their eggs, and are noted as being busiest at work about 8 o'clock in the evening. In the morning they may be found resting on the lower part of the culm of the wheat, with their heads downwards, flying about, however, in great numbers near the ground when the stems are shaken," which habits I can corroborate.

The larvae hatch in nine or ten days (a few took twelve days). They are almost transparent at first, gradually turning yellow, and then changing to an orange-red. When full-fed some of the larvae leave the ears of the corn and fall to the ground; here they bury themselves in the soil, and remain as larvae for a fortnight or even more, ultimately changing to pupae. Some of the larvae remain in the corn. The pupae are enclosed in filmy cases, and are reddish in colour.

In addition to attacking wheat, this species attacks rye, oats, barley, couch and other grasses. It has been thought by some writers that the female first lays her egg on couch, meadow foxtail, wild oat, and other grasses, and that the wheat is infested from broods from this source. There are probably two or three broods in a year, but I do not think that the first is confined to couch and wild grasses.

PREVENTIVE AND REMEDIAL MEASURES.

All wild grasses near to cornfields, such as those mentioned above, should be destroyed.

The destruction of all chaff and dust from the threshing machine is an important matter, for when thrown on one side it forms an admirable breeding ground for the Midge, clouds of which come out in the following May or June ready to infest the wheat.

As with other species of flies belonging to this family, the proper treatment on the field is to bury the surface soil. This has proved effective in Canada and elsewhere.

THE STABLE FLY.

Stomoxys calcitrans, Linn.

Numerous specimens of this insect have been sent in for identification by various correspondents. Newstead ² has recently given a very full account of its life-history, from which this is taken. He states farmyards and stables are evidently the favourite haunts of this fly; it occurs also in the fields, parks, and open woods, especially where cattle are grazing, but is much less numerous in such places. It is evidently

¹ Manual Inj. Insects, 1890, p. 89.

² Journ. Econ. Biology, 1907, vol. i, pp.

also by no means uncommon in some of our large towns, and numbers were seen at rest on the shop fronts in the main streets. It is fond of resting on surfaces fully exposed to the sun, such as doors, gates, and rails, and to a less extent on stone and brick walls. They are very active; but their flight is quite inaudible at a short distance, the noise produced being quite feeble. When disturbed they frequently return to the same spot, but more especially so in favourite resting-places. At night they retire to some sheltered spot, and numbers may be found at rest on the beams and rafters in open sheds in farmyards, where they remain, almost inert till the morning sun tempts them out again. They will occasionally enter stables in the day time, and they were seen to enter such places through a narrow opening or a crack in the door.

They frequently clean their wings when in captivity, and this is accomplished with great precision, the legs being used for this purpose. The under surface of the wings are first combed, then the upper, the legs are then rubbed together, and the process is again repeated in exactly the same order.

During the heat of the day the males preponderated: the ratio was about three males to one female; but towards evening the sexes occurred in about equal numbers; the captured females were, however, nearly all freshly-emerged ones, and a large proportion of the eggs which they laid in captivity proved infertile.

During a period of fourteen days a careful watch was kept on both cattle and horses in various farmyards where the flies were common, but no flies were seen either to alight upon the animals or to suck blood from them: at the same time several examples of both males and females were captured which were fully engorged with blood. Moreover, a freshly-emerged male readily sucked blood from Mr. Newstead's hand. There is, however, no lack of authentic evidence as to the blood-sucking habits of this fly.

Two specimens were seen to settle on fresh cow dung, and apparently feed upon the moisture on it, passing the extended proboscis rapidly over the surface; such habits were apparently exceptional or rarely seen in a state of nature; but in captivity they readily fed on the fresh faeces of the horse and sheep, more especially so on the latter. A female was also seen to drive its proboscis into the thorax of a dead companion, and apparently suck up the juices of its body. Three specimens fed upon some sugar and water, and also some sucked up the moisture from a decayed and fetid potato.

In captivity they lived several days; but they were supplied with an abundance of fresh air and some moist faeces. The females died immediately, or shortly after laying their eggs.

When the female is about to lay its eggs the ovipositor becomes

fully extended, and nearly equals the length of the abdomen proper. The eggs are passed rapidly down the ovipositor at intervals of a few seconds, and were usually laid in an irregular heap. In some instances the female was seen to separate the eggs by carefully passing her proboscis between them, and then drag them away or scatter them with her legs. In cases where the eggs were laid during *extremis* the female generally died on the spot, and made no attempt to scatter them. Counts were made of seven batches, the maximum being seventy-one, the minimum forty-eight; the actual counts were forty-eight, forty-eight, fifty-four, fifty-seven, fifty-nine, sixty-two, seventy-one. The incubation period, at an average temperature of 72° F. in the day, and 65° F. at night, was two to three days.

They are especially abundant during August and September; but gradually diminish in numbers during the early part of October; and few examples are seen after a spell of cold wet weather.

The egg is coriaceous; white at first, but changing to creamy white. Those which are laid on faeces, fully exposed to the sun, had the exposed portions tinged with pinkish-brown, but this colour eventually disappeared. Form, very elongate, shaped somewhat like a banana, being curved on one side, and almost straight on the other; the straight side with a broad groove, which widens at the anterior end, giving it a spatuloid form. Surface with faint polygonal reticulations. The larva effects its escape by splitting the broad end of the groove, leaving it slightly raised, and apparently intact on the opposite side. Length, 1 mm.

The larvae move rapidly along a smooth surface, pulling themselves along chiefly by means of a large mouth hook; and proceed practically in a straight line, moving the head rapidly, but irregularly, from side to side, or up and down. There is, however, no regular alternate movement of the head during progression as in muscid larvae. Their progress through the burrows in their food is much more rapid than on a smooth surface, and when disturbed they disappear with extraordinary rapidity. The larval stage lasted, under favourable conditions, from 14 to 21 days; but the absence of excessive moisture and the admission of a little light materially retarded their development, which then extended over a period of from 31 to 78 days. The larvae exposed to such conditions produced much smaller pupae, and correspondingly small imagines.

Pupation is completed in about two hours. At first the larva rapidly shortens itself, chiefly by contracting the anterior segments, and becomes barrel-shaped. At this period it is of a creamy-white colour, and the mouth parts of the larvae are still visible through the soft integument. The colour rapidly changes to bright ochreous, and

in the space of two hours, or even less, the integument hardens, and the puparium assumes its normal colour. In cases where soil was placed below the faeces the larvae generally burrowed into the former to a depth of about half an inch, but a few also pupated in the dryer portions of the dung. Where no soil was provided the larvae generally pupated at the bottom of the breeding cage.

A few days before the emergence of the insect the cuticle of the puparium darkens, and eventually splits anteriorly along the lateral and median lines, and also transversely along the fourth segment; the section falls away, and the fly escapes. Prior to this the nymph undergoes its final ecdysis, pushing its effete skin off backwards into the posterior end of the puparium. On its emergence it appears as a small dark-grey fly, with thick rudimentary wings of a dull leaden colour, and a deep notch in the mid costa, below which are strong convoluted folds. The head is much larger and wider than the thorax, and the abdomen is attenuated.

THE PLUM SAWFLY.

Hoplocampa fulvicornis, Klug.

In the Evesham district the larvae of this fly have been the cause of much damage and loss. Observations made during the spring of 1907 show that in Worcester and Hereford it is on the increase.

I hope to issue a full account of its life-history and suggested remedies shortly.

THE APPLE SAWFLY.

Hoplocampa testudinea.

This is another hymenopterous insect, which, so far as I am aware, has not previously recorded for the Midlands. During the past season it was found in an orchard in Worcestershire, but only a few trees were attacked, and I think most of the fruit was picked off.

How long it has been in the Midlands I cannot say, for it is quite possible that it may have been mistaken for the larvae of the Codling Moth, from which, however, it differs by its greater number of legs.

GENERAL NOTES ON OTHER INJURIOUS INSECTS, ETC.

THE RASPBERRY BEETLE (*Byturus tomentosus*, Fabr.).—Two examples of this beetle have been received from Staffordshire, where some few years back it was fairly plentiful. Deeply burying the surface soil has proved most effective, as also careful attention to burning prunings, old canes, etc.

THE BEAN APHIS.—Considering what a plague there has been of Aphids of all species during 1906, but very few attacks of the Bean Aphis (*Aphis rumicis*, Linn.) have been reported in the Midlands, and only one of a serious nature.

THE APPLE BLOSSOM WEEVIL (*Anthonomus pomorum*, Linn.).—This pest has been received from Worcester and Hereford, but it is nothing like so plentiful as it was a few years back. A full account of the life-history and preventive and remedial measures is given in my second Annual Report for 1904, p. 21.

THE WINTER MOTH (*Cheimatobia brumata*, Linn.).—Owing very largely to the failure of many growers to put grease-bands on the tree, this insect is rapidly increasing in the Midlands, and ere long will prove a most serious pest to fruit-growers. (See 2nd Annual Report for 1904, p. 31, for life-history, etc.)



FIG. 6.—1.—Male Moth. 2.—So-called wingless female.

THE GREAT YELLOW UNDERWING MOTH (*Triphaena pronuba*, Linn.).—Many examples have been received of this all too common pest, and reports containing remedial measures have been forwarded to the different correspondents. In common with all species of surface larvae, it has been unusually plentiful during 1906.

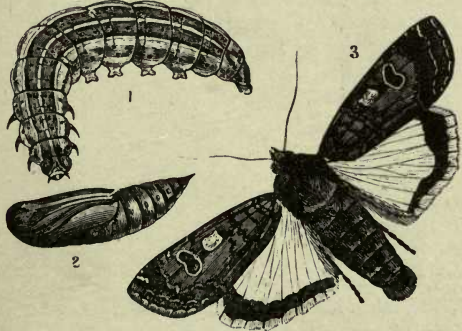


FIG. 7.—1.—Larva. 2.—Pupa. 3.—Moth.

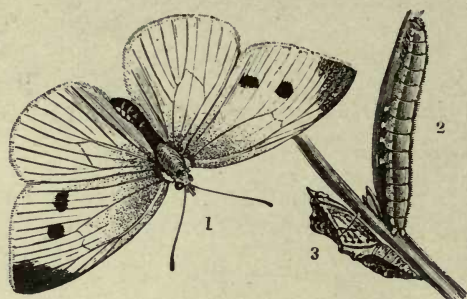


FIG. 8.—1.—Female butterfly. 2.—Larva.
3.—Pupa.

THE SMALL WHITE CABBAGE BUTTERFLY (*Pieris rapae*, Linn.)—Numerous examples have been received of the larvae and pupae of this species, the latter especially from local market gardeners, nurserymen, and amateur gardeners.

ORCHIDS INJURED BY MILLIPEDES.—A Worcester correspondent forwarded in December last a number of Orchid roots seriously damaged by two millipedes—*Polydesmus complanatus*, Linn., and *Blaniulus guttulatus*, Bosc.

The following method has been adopted by a Warwick correspondent with splendid results:—Dig out in flower beds a hole sufficiently large to contain the fist and wrist, and fill with bran (bran saturated with beer was thought not to give such good results), and cover with a flower pot. After two or three days pour on to the bran boiling water. The contents of two such holes were carefully counted—one contained 2,448 dead millipedes, and the other 1,793. In both cases there were probably two or three hundred left behind.

PLUM BARK BEETLE (*Scolytus rugulosus*, Ratze.).—A Warwickshire fruit-grower forwarded early in the year numerous examples of this beetle from a Plum tree in his orchard. As is invariably the case, the tree was in a very poor condition, and was destroyed by burning in the spring.

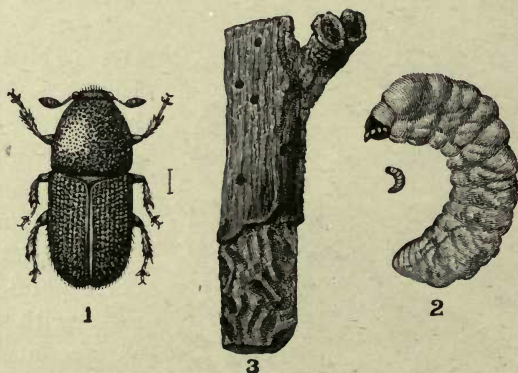


FIG. 9.—1.—Beetle magnified, line showing natural length. 2.—Larva, natural size, and much magnified. 3.—Piece of apple branch, showing holes in bark made by the beetle, and channels made in the wood.

APPENDIX A.

INSTRUCTIONS FOR USING HYDROCYANIC ACID GAS.

This, the most powerful and dangerous poison used in combating insect pests, should on no account be used by uninstructed or careless people.

The materials required are a 2 lb. pot jam-jar, in which place 7 ozs. of water, to which add 4 ozs. of sulphuric acid and, as directed below, 2 ozs. of 98 per cent. cyanide of potassium for every 1,000 cubic feet of space.

First make the room to be fumigated as air-tight as possible, leaving one window to open from the outside. Then wrap up the pieces of cyanide in blotting-paper. Having placed in the jam-jar the water and acid, place the jar just within the room to be fumigated, draw the door nearly to, and with the arm reach in and drop the wrapped-up cyanide into the jar, and close the door immediately. Strips of paper well sized should then at once be placed over the crevices.

The room should remain closed for from two to three hours; then open the window from the outside, and leave until thoroughly well ventilated. Remember the fumes and the cyanide are deadly poison. Care should be taken that no one remains outside the door of the room as in a passage, as some of the fumes might escape.

In conservatories, greenhouses, etc., proceed as follows:—Add the 4 ozs. of sulphuric acid to the 7 ozs. of water in a jar; then take the cyanide, which should be wrapped up in blotting paper, and by means of a stick or piece of string drop it into the water from the outside of the greenhouse. The window or door should then be shut, and the house should remain closed for three-quarters of an hour at least, after which time they can be opened to ventilate, but it should be remembered that it is unsafe to enter the house until an hour or more after the windows and doors have been opened. The best results have been obtained at a temperature of 50° F., about one hour after sunset, when the foliage is dry.¹

¹ Mr. G. F. Strawson informs me that he has obtained better results by pouring the diluted acid upon the cyanide of potassium, using no blotting paper. He has also devised and successfully used in conservatories, &c., a series of fans, consisting of boards suspended by two cords with a string at each side. The strings to the right and left are worked through a hole in the doors, or other woodwork,

INSTRUCTIONS FOR USING BISULPHIDE OF CARBON.

The fumes of this chemical, in addition to being deadly poison to all animal life, are also highly inflammable. No light—such, for instance, as a lighted cigar or pipe—should be brought near it, nor should it be used where there are electric wires.

For fumigating stores it is best used in a large air-tight tin, into which the goods are placed, and then pour the bisulphide into a saucer placed upon the goods in the proportion of one pound (1 lb.) to every thousand (1,000) cubic feet of space. The liquid should be poured out quickly in order not to inhale the fumes—there is no danger in inhaling a small quantity—and the bin closed and kept shut for at least five hours, after which time it should be well ventilated, as also the fumigated goods.

APPENDIX B.

For the benefit of those possessing no special knowledge of Entomology, it may be well to point out that, with a few exceptions, all insects are hatched from eggs. From the eggs, the *larvae* or caterpillars hatch out, and after a time these change into *pupae* or chrysalides, each ultimately developing into an *imago*.

The Eggs.—These are exceedingly variable in shape, size, and colour. They may be laid singly or in groups. Sometimes they are protected by a gummy secretion, whilst others are fastened by a short thread. The food of the young in nearly all cases determines the place where the eggs are deposited, such, for instance, as on leaves, close to or in roots, in blossom buds, beneath the bark of trees, on cattle, meat or decaying animal or vegetable matter. The number of eggs laid by a single insect may be very few or many thousands; fifty to a hundred, however, may be taken as an average. The period of hatching, generally speaking, is not of long duration, though there are cases where they remain unhatched for a considerable length of time.

The Larva.—In a few cases this is produced alive, but usually it is hatched from an egg. The larvae of Butterflies, Moths, and Sawflies are commonly spoken of as *caterpillars*, those of Beetles as *grubs*, while those of Flies are known as maggots.

If a larva possesses legs, the first three segments behind the head each carry a pair, which are jointed and known as *thoracic* or true legs. Legs may also be present on the posterior segments, but these are never jointed; they are known as *pseudopods* or *prolegs*.

It is often very difficult to say exactly to what particular order

a larva belongs, but speaking in general terms, we may say that the larvae of Butterflies and Moths exhibit the following characters: A well-defined head provided with biting jaws, a pair of jointed limbs on each of the first three segments behind the head, a pair of pseudopods on the sixth, seventh, eighth and ninth segments, and sometimes a pair of larger anal feet on the twelfth segment, making a total of sixteen. The "Looper" caterpillars have pseudopods on the ninth and twelfth segments, making a total of ten. The caterpillars of a few months are footless.

The larvae of Beetles possess a well-defined head and biting jaws, and a pair of jointed legs on the first three segments behind the head (Rose Chafer) or legs are entirely absent (Garden Weevil).

The larvae of Flies (Diptera) are generally legless and usually the head is merged into the thorax; some, however, possess pseudopods and a head.

Those of the Hymenoptera (*e.g.*, sawflies, wood wasps, etc.) have six, eighteen, or twenty-two appendages, and in sawfly larvae the second abdominal segment always has a pair of pseudopods; in some cases (wood wasps) the limbs are vestigial, while in other cases they are absent.

The larval stage is usually the one in which the insect does the greatest amount of damage; they feed voraciously, the daily consumption of food often exceeding many times the weight of the larva. With a plentiful supply of food they rapidly increase in size, and, as the chitinous skin is only capable of a limited expansion, it ultimately splits, and the larva comes out with a new, and sometimes differently-coloured skin. This process, known as *moulting*, usually takes place five times, but the number is variable; 2, 3, 4, 5, 7, 10, 11, 12, and even 20, 25, and 30 moults are known in different insects. The larva is now said to be full-fed, and it changes to a pupa or chrysalis.

The duration of the larval period is subject to much variation; sometimes it is only a few days, while in other cases it may last for months or even years.

The Pupa.—The full-fed larva generally either buries itself in the ground (Rose Chafer), forming a cell of earthy particles, or spins a silky cocoon (Codling Moth), in which it changes to the pupal condition. After a time the pupal case containing the insect cracks or splits, and the perfect insect or *imago* creeps out.

The Imago.—This is the fully-formed insect, and may be described as an animal consisting of thirteen segments, breathing by tracheal tubes, with a single pair of feelers, and having the body divided up into three distinct regions—head, thorax, and abdomen—the three segments of the thorax each carrying a pair of jointed legs.

On reaching the imago stage, the pairing of the sexes is soon effected; the female then lays her eggs, and shortly afterwards dies, the *generation* or *life-cycle* being thus completed. In some cases the perfect insect only lives a few hours or days, but in others they hibernate during the winter, and lay their eggs in the following spring.

Before the depredations of any particular species of insect can be effectively dealt with, it is important that all the stages and variations of the life-cycle should be clearly and thoroughly understood.

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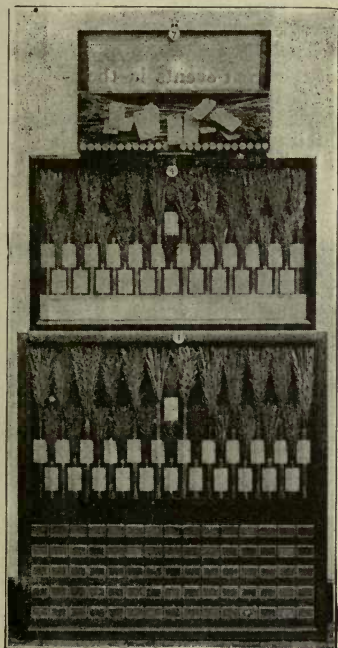
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